



DECLARATION

I, Kimio Ozaki of c/o SHIGA INTERNATIONAL PATENT OFFICE,
2-3-1 Yaesu, Chuo-ku, Tokyo 104-8453 JAPAN, understand both
English and Japanese, am the translator of the English document attached, and do hereby
declare and state that the attached English document contains an accurate translation of the
official certified copy of Japanese Patent Application No. 2000-391703
and that all statements made herein are true to the best of my knowledge.

Declared in Tokyo, Japan

This 11th of August, 2005



Kimio Ozaki



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This is to certify that the annexed is a true copy of the following application as filed with this office.

Date of Application : December 22, 2000

Application Number : Patent Application No. 2000-391703

Applicant(s) : Honda Giken Kogyo Kabushiki Kaisha

Dated November 26, 2001

Commissioner, Japan Patent Office Kozo Oikawa

No. 2001-3102172

(Title of the Document)	Patent Application
(Docket Number)	J86588A1
(Filing Date)	December 22, 2000
(Destination)	Commissioner, Japan Patent Office
(International Classification)	C01B 3/00
(Title of Invention)	A FUEL GAS GENERATING APPARATUS FOR A FUEL CELL
(Number of Claims)	8
(Inventor)	
(Address)	c/o K.K. Hon-da Gijutsu Kenkyusho, 4-1, Chuo 1-chome, Wako-shi, Saitama-ken
(Name)	Hikaru OKADA
(Inventor)	
(Address)	c/o K.K. Hon-da Gijutsu Kenkyusho, 4-1, Chuo 1-chome, Wako-shi, Saitama-ken
(Name)	Yasunori KOTANI
(Inventor)	
(Address)	c/o K.K. Hon-da Gijutsu Kenkyusho 4-1, Chuo 1-chome, Wako-shi, Saitama-ken
(Name)	Atsushi SAKUMA
(Applicant for Patent)	
(Identification Number)	000005326
(Name)	Honda Giken Kogyo Kabushiki Kaisha
(Agent)	
(Identification Number)	100064908
(Patent Attorney)	
(Name)	Masatake Shiga
(Elected Agent)	
(Identification Number)	100108578
(Attorney)	
(Name)	Norio Takahashi
(Elected Agent)	
(Identification Number)	100101465

(Attorney)
(Name) Masakazu Aoyama

(Elected Agent)
(Identification Number) 100094400
(Attorney)
(Name) Mitsuyoshi Suzuki

(Elected Agent)
(Identification Number) 100107836
(Attorney)
(Name) Kazuya Nishi

(Elected Agent)
(Identification Number) 100108453
(Attorney)
(Name) Yasuhiko Murayama

(Official Fees)
(Prepayment Docket Number) 008707
(Amount of Payment) 21000

(List of Documents Submitted)
(Item) Specification 1
(Item) Drawing 1
(Item) Abstract 1
(General Power of Attorney Number) 9705358

[Document Type] Specification

[Title of the Invention] A FUEL GAS GENERATING APPARATUS FOR A FUEL CELL

[Claims]

[Claim 1]

A fuel gas generating apparatus for a fuel cell comprising:
a vaporizer for generating a fuel vapor by vaporizing a raw liquid fuel;
an auto thermal reformer for generating a reformed gas containing hydrogen from a partially oxidized raw fuel gas obtained by adding reforming air to the fuel vapor generated by said vaporizer; and

a CO eliminator for generating a fuel gas by eliminating carbon monoxide from said reformed gas generated by said auto thermal reformer, by adding CO eliminating air; wherein,

the fuel gas generating apparatus further comprises reforming air amount control means for performing a control operation such that the supply amount of said reforming air during a warm-up operation of said reformer becomes larger than the supply amount of the reforming air during an idle operation after completion of the warm-up operation.

[Claim 2]

A fuel gas generating apparatus for a fuel cell according to claim 1, wherein
the fuel gas generating apparatus further comprises fuel amount control means for performing a control operation such that the supply amount of said raw liquid fuel during the warm-up operation of said reformer becomes larger than the supply amount of said raw liquid fuel during the idle operation after completion of the warm-up operation.

[Claim 3]

A fuel gas generating apparatus for a fuel cell according to claim 2, wherein the increase ratio of the supply amount of the reforming air by said reforming air amount control means is set to be greater than the increase ratio of the supply amount of the raw

liquid fuel by said fuel amount control means.

[Claim 4]

A fuel gas generating apparatus for a fuel cell according to any one of claim 1 to claim 3, wherein when a temperature corresponding to the warm-up state of said reformer is detected, and this detected temperature becomes higher than a predetermined temperature, the supply amount of the reforming air, which has been increased by said reforming air amount control means during the warm-up operation of the reformer, is then decreased.

[Claim 5]

A fuel gas generating apparatus for a fuel cell according to claim 4, wherein when the supply amount of said reforming air is controlled to be reduced, the reduction is made depending on said detected temperature.

[Claim 6]

A fuel gas generating apparatus for a fuel cell according to claim 4 or claim 5, wherein at least one of the temperature of the catalyst within said reformer, the temperature of said reformed gas, and the temperature of the case of said reformer is used as said detected temperature.

[Claim 7]

A fuel gas generating apparatus for a fuel cell comprising:
a vaporizer for generating a fuel vapor by vaporizing a raw liquid fuel;
an auto thermal reformer for generating a reformed gas containing hydrogen from a partially oxidized raw fuel gas obtained by adding reforming air to the fuel vapor generated by said vaporizer; and
a CO eliminator for generating a fuel gas by eliminating carbon monoxide from said reformed gas generated by said auto thermal reformer, by adding CO eliminating air; wherein,

the fuel gas generating apparatus further comprises CO eliminating air amount control means for performing a control operation such that the supply amount of said

CO eliminating air during a warm-up operation of said CO eliminator becomes larger than the supply amount of CO eliminating air during an idle operation after completion of the warm-up operation.

[Claim 8]

A fuel gas generating apparatus for a fuel cell according to any one of claim 1 to claim 7, wherein said fuel gas is supplied to the fuel cell after it is determined that warm-up operations of said auto thermal reformer and said CO eliminator have been completed.

[Detailed Description of the Invention]

[0001]

[Technical Field of the Invention]

The present invention relates to a fuel gas generating apparatus for a fuel cell comprising an auto thermal reformer that reforms a hydrocarbon fuel into a hydrogen rich gas, and in particular to a fuel gas generating apparatus for a fuel cell having superior start-up characteristics.

[0002]

[Prior Art]

There is a known conventional fuel cell system, where a hydrocarbon fuel such as methanol or methane is reformed into a hydrogen rich fuel gas by a fuel gas generating apparatus comprising an auto thermal reformer, and then this hydrogen rich fuel gas as well as an oxidizing gas (for example, air) are supplied to a fuel cell in order to generate electric power (refer to Japanese Unexamined Patent Application, First Publication, No. 2000-154002, Japanese Unexamined Patent Application, First Publication, No. 2000-53403 and the like).

[0003]

The above described fuel gas generating apparatus normally comprises a vaporizer, which generates a fuel vapor by vaporizing a raw liquid fuel that is a mixture of water and a raw fuel such as methanol, methane, or the like; an auto thermal reformer (hereafter, referred to as "reformer"), which generates a hydrogen rich reformed gas from a partially oxidized raw fuel gas obtained by adding reforming air to the fuel vapor

generated by the vaporizer; a heat exchanger, which lowers the temperature of the reformed gas generated by the reformer; a CO eliminator, which generates a fuel gas by eliminating the carbon monoxide from the reformed gas by adding CO eliminating air to the reformed gas, whose temperature has been lowered by the heat exchanger; and a fuel cell, which generates electricity by an electrochemical reaction between the fuel gas supplied to an anode electrode and the air (oxidizing gas) supplied to the cathode electrode.

[0004]

In this fuel gas generating apparatus, the system as a whole must be warmed up until the gas composition of the fuel gas after start-up stabilizes and the fuel gas temperature stabilizes at a temperature that allows supplying the fuel gas to the fuel cell.

In the conventional warm-up method, available heat sources are, for example, a start-up burner being installed in the reformer; a heater being provided on the reformer; and a heat medium (for example, air), which has been heated up by the heater, being allowed to flow to the heat exchanger as well as the CO eliminator. First, by supplying external heat using these heat sources, cooling water for the heat exchanger as well as cooling water for catalytic temperature adjustment of the CO eliminator are warmed up, the catalyst in the reformer as well as the catalyst in the CO eliminator are warmed up to a temperature equal to or greater than the active temperature, the system is warmed up to a temperature equal to or greater than the fuel gas dew point temperature, and at the same time, the vaporizer is warmed up. After the warm-up of the vaporizer has been completed, the reforming reaction is activated by supplying the reformer with both of the fuel vapor generated in the vaporizer and the reforming air, using each supply amount for the idling operation after the warm-up is completed. The warm-up is carried out starting from the reformer, which is in the front end, and the warm-up progresses gradually towards the back end.

[0005]

[Problems to be Solved by the Invention]

However, in this warm-up method, a long period of time is required until the catalyst of the CO eliminator at the back end reaches the activation temperature. Also, a long period of time is required for warming up the cooling water for adjusting the temperature of the catalyst in the CO eliminator, and the gas flow path in the system.

As a result, the warm-up of the system as a whole may require tens of minutes, and in addition, several minutes are required for stabilizing the composition of the fuel gas.

[0006]

In the case of being employed in an industrial field requiring a fast start-up, and in particular, in fuel cell vehicles, in order to make driving possible until the composition of the fuel gas stabilizes, a large-capacity storage battery must be installed, and thus there is a problem such that the system becomes a large size.

Thus, it is an object of the present invention to provide a fuel gas generating apparatus for a fuel cell, which enables the fast warm-up of the reformer, the CO eliminator, the system gas flow path, and the like, and also enables the fast stabilization of the fuel gas composition.

[0007]

[Means for Solving the Problem]

In order to solve the above described problems, the invention according to claim 1 of the present invention is a fuel gas generating apparatus for a fuel cell (for example, the fuel gas generating apparatus 1 in the embodiment described below) comprising: a vaporizer (for example, the vaporizer 22 in the embodiment described below) for generating a fuel vapor by vaporizing a raw liquid fuel; an auto thermal reformer (for example, the reformer 11 in the embodiment described below) for generating a reformed gas containing hydrogen from a partially oxidized raw fuel gas obtained by adding reforming air to the fuel vapor generated by the vaporizer; and a CO eliminator (for example, the CO eliminator 13 in the embodiment described below) for generating a fuel gas by eliminating carbon monoxide from the reformed gas generated by the auto thermal reformer, by adding CO eliminating air; wherein, the fuel gas generating apparatus further comprises reforming air amount control means (for example, step S112 in the embodiment described below) for performing a control operation such that the supply amount of the reforming air during a warm-up operation of the reformer becomes larger than the supply amount of the reforming air during an idle operation after completion of the warm-up operation.

[0008]

Due to having this type of structure, oxygen in the air supplied in excess to the reformer during warm-up is combusted by a catalyst inside the reformer, and this

combustion heat heats up the reformer and the reformed gas. In addition, the CO eliminator and the gas flow path in the system are heated up by the heated reformed gas flowing downstream.

[0009]

The invention according to claim 2 of the present invention is in the invention claimed in claim 1, the fuel gas generating apparatus further comprises fuel amount control means (for example, step S112 in the embodiment described below) for performing a control operation such that the supply amount of the raw liquid fuel during the warm-up operation of the reformer becomes larger than the supply amount of the raw liquid fuel during the idle operation after completion of the warm-up operation.

Due to having this type of structure, the amount of generated heat in the reformer during the warm-up operation is increased further, and at the same time the amounts of hydrogen, CO, and unreacted hydrocarbons flowing out from the reformer during the warm-up operation are increased.

[0010]

The invention according to claim 3 of the present invention is in the invention claimed in claim 2, the increase ratio of the supply amount of the reforming air by the reforming air amount control means is set to be greater than the increase ratio of the supply amount of the raw liquid fuel by the fuel amount control means. Due to having this type of structure, the amount of oxygen to be combusted by the catalyst in the reformer can be secured.

[0011]

The invention according to claim 4 of the present invention is in the invention claimed in any one of claim 1 to claim 3, when a temperature corresponding to the warm-up state of the reformer is detected, and this detected temperature becomes higher than a predetermined temperature, the supply amount of the reforming air, which has been increased by the reforming air amount control means during the warm-up operation of the reformer, is then decreased. Due to having this type of structure, the overheating of the catalyst in the reformer can be prevented.

[0012]

The invention according to claim 5 of the present invention is in the invention claimed in claim 4, when the supply amount of the reforming air is controlled to be

reduced, the reduction is made depending on the detected temperature. Due to having this type of structure, the warm-up state of the reformer can be gradually stabilized.

[0013]

The invention according to claim 6 of the present invention is in the invention claimed in claim 4 or claim 5, at least one of the temperature of the catalyst within the reformer, the temperature of the reformed gas, and the temperature of the case of the reformer is used as the detected temperature. Due to having this type of structure, when the reformer has been warmed-up to a predetermined state, the supply amount of the reforming air, to which an increase correction has been performed, can be controlled so as to be reduced, and as a result the overheating of the catalyst in the reformer can be reliably prevented. Here, because “at least one” is specified, any one of the temperature of the catalyst in the reformer, the temperature of the reformed gas, and the temperature of the case of the reformer can be used, or one of the lowest temperature among these can be used, or one of the highest temperature among these can be used.

[0014]

The invention according to claim 7 of the present invention is a fuel gas generating apparatus for a fuel cell (for example, the fuel gas generating apparatus 1 in the embodiment described below) comprising: a vaporizer (for example, the vaporizer 22 in the embodiment described below) for generating a fuel vapor by vaporizing a raw liquid fuel; an auto thermal reformer (for example, the reformer 11 in the embodiment described below) for generating a reformed gas containing hydrogen from a partially oxidized raw fuel gas obtained by adding reforming air to the fuel vapor generated by the vaporizer; and a CO eliminator (for example, the CO eliminator 13 in the embodiment described below) for generating a fuel gas by eliminating carbon monoxide from the reformed gas generated by the auto thermal reformer, by adding CO eliminating air; wherein, the fuel gas generating apparatus further comprises CO eliminating air amount control means (for example, step S112 in the embodiment described below) for performing a control operation such that the supply amount of the CO eliminating air during a warm-up operation of the CO eliminator becomes larger than the supply amount of CO eliminating air during an idle operation after completion of the warm-up operation.

[0015]

Due to having this type of structure, the hydrogen, the carbon monoxide, and the unreacted hydrocarbons flowing out from the reformer during the warm-up operation are sufficiently combusted by the catalyst in the CO eliminator, along with the oxygen in the CO eliminating air that is supplied in excess, and the CO eliminator can be heated up by this combustion heat. Furthermore, the gas flow path in the system can be heated up due to this combustion gas flowing downstream.

[0016]

The invention according to claim 8 of the present invention is in the invention claimed in any one of claim 1 to claim 7, the fuel gas is supplied to the fuel cell after it is determined that warm-up operations of the auto thermal reformer and the CO eliminator have been completed. Due to having this type of structure, a fuel gas that has been controlled to have a predetermined gas composition and a predetermined gas temperature can be supplied to the fuel cell.

[0017]

[Embodiments of the Invention]

Below, a gas fuel generating apparatus for a fuel cell according to an embodiment of the present invention will be explained while referring to FIG. 1 through FIG. 11. Moreover, the embodiment explained below is a type where the fuel gas generating apparatus for a fuel cell is mounted on a fuel cell vehicle.

FIG. 1 is a schematic drawing of the fuel gas generating apparatus for a fuel cell (hereinafter, referred to as “fuel gas generating apparatus”), and the fuel gas generating apparatus 1 is configured with a reforming reactor 10, a fuel cell stack (fuel cell) 21, and a vaporizer 22 as main components, and the reforming reactor 10 comprises a reformer 11, a heat exchanger 12, a CO eliminator 13, and a start-up burner 14.

[0018]

The fuel cell stack 21 is a solid polymer-type fuel cell, and generates electricity by causing an electrochemical reaction between the hydrogen in the fuel gas supplied to the anode electrode and the oxygen in the air, which serves as an oxidizing agent, supplied to the cathode cell.

The vaporizer 22 vaporizes a raw liquid fuel into a fuel vapor, which is then reformed by the reforming reactor 10 to obtain a hydrogen rich fuel gas. The

hydrogen rich fuel gas is supplied to the anode electrode of the fuel cell stack 21 to be used as the fuel gas.

[0019]

In other words, the raw liquid fuel for reforming, which comprises a hydrocarbon fuel (for example, methanol) and water mixed at a predetermined ratio, and the air for reforming (hereafter, referred to as the “reforming air”) are supplied to the vaporizer 22; the raw liquid fuel and the reforming air in the vaporizer 22 are heated up; and the raw liquid fuel becomes a fuel vapor by being vaporized and is supplied to the reformer 11 of the reforming reactor 10 via the fuel supply duct 31 from the vaporizer 22, in a state mixed with the heated reforming air.

[0020]

The reformer 11 of the reforming reactor 10 is an auto thermal reformer provided with a palladium (Pd)-type precious metal catalyst that serves as the reforming catalyst inside, and generates a hydrogen rich reformed gas from a partially oxidized raw fuel gas obtained by adding reforming air to the fuel vapor generated by the vaporizer 22. After the reformed gas generated by the reformer 11 has been cooled by the heat exchanger 12, it is supplied to the CO eliminator 13. The CO eliminator 13 is provided inside with a platinum (Pt)-type catalyst capable of being active at low temperatures, and at the same time, can be provided with air for CO elimination (hereafter, referred to as CO eliminating air). In the CO eliminator 13, the CO in the reformed gas is oxidized to become CO₂, that is, the fuel gas is generated by eliminating the CO in the reformed gas. In addition, in the CO eliminator 13, cooling water for cooling the fuel gas can be circulated. Raw liquid fuel and air can be supplied to the start-up burner 14, and only during the warm-up time, the raw fuel and air are supplied to the burner 14 and ignited.

[0021]

The fuel gas reformed by the reforming reactor 10 is supplied to the anode electrode of the fuel cell stack 21 via fuel gas supply ducts 32 as well as 33 and a three-way selector valve 34. Air can be supplied as an oxidizing agent gas to the cathode electrode of the fuel cell stack 21 from a supercharger (not illustrated) via an air supply duct 35.

[0022]

After the fuel gas supplied to the anode electrode of the fuel cell stack 21 has been provided for an electric power generation, it is supplied to the vaporizer 22 via a fuel off gas pipe 36 as a fuel off gas, on the other hand, after the air supplied to the cathode electrode has been provided for the electric power generation, it is supplied to the vaporizer 22 via an air off gas pipe 37 as an air off gas. In addition, the three-way selector valve 34 is connected to the fuel off gas pipe 36 by a bypass pipe 38 that bypasses the fuel cell stack 21, and the three-way selector valve 34 can selectively connect the fuel gas supply duct 32 to either the fuel gas supply duct 33 or the bypass pipe 38. When the three-way selector valve 34 connects the fuel gas supply duct 32 and the fuel gas supply duct 33, the fuel gas flowing out from the reforming reactor 10 is supplied to the fuel cell stack 21, and when the three-way selector valve 34 connects the fuel gas supply duct 33 and the bypass pipe 38, the fuel gas flowing out from the reforming reactor 10 bypasses the fuel cell stack 21 and flows through the bypass pipe 38.

[0023]

The fuel off gas and the air off gas discharged from the fuel cell stack 21 are introduced into a catalytic combustor built into the vaporizer 22, and are combusted in this catalytic combustor. Then, the raw liquid fuel for reforming and the reforming air supplied to the vaporizer 22 are heated up by this combustion heat. Moreover, in the vaporizer 22, the fuel off gas and the air off gas that serve as the heat source in the vaporizer 22 are discharged to the atmosphere via the discharge pipe 39.

[0024]

Next, the operation of the fuel gas generating apparatus 1 will be explained. In this fuel gas generating apparatus 1, in order to obtain a fast warm-up, the supply amount of each of raw liquid fuel, reforming air, and CO eliminating air during the warm-up operation is made greater than the respective supply amount after completion of the warm-up operation. Moreover, the amount of the raw fuel has a proportional relationships with the amount of the reformed gas and the amount of the fuel gas.

Here, the warm-up operation is carried out when the internal system temperature is low, for example, during start-up, and is not carried out when the internal system is sufficiently warm during restarting or the like.

During the warm-up of the fuel gas generating apparatus 1 (that is, during the

warm-up of the reformer 11), when excess reforming air is supplied to the reformer 11 by increasing the supply amount of the reforming air, the oxygen in the excessively supplied air is combusted by the reforming catalyst, and this combustion heat heats up the case of the reformer 11, the reforming catalyst, and the reformed gas. Thereby, the warm-up of the reformer 11 is accelerated.

[0025]

In addition, during warm-up of the fuel gas generating apparatus 1 (that is, during the warm-up of the reformer 11), when an excess fuel vapor is supplied to the reformer 11 by increasing the supply amount of a raw liquid fuel, the amount of the fuel vapor combusted in the reformer 11 also increases, and thus the amount of generated heat in the reformer 11 increases, and thereby the warm-up operation of the reformer 11 is also accelerated.

On top of this, due to the reformed gas quickly heated up in this manner flowing downstream, the CO eliminator and the gas flow path are also heated up, and thus their warm-up operations are also accelerated.

[0026]

In addition, during the warm-up of the fuel gas generating apparatus 1, not only hydrogen and carbon monoxide flow out from the reformer 11, but large amounts of unreacted hydrocarbons also flow out. However, when the amount of the CO eliminating air supplied to the CO eliminator is increased during the warm-up of the fuel gas generating apparatus 1 (that is, during the warm-up of the CO eliminator 13), the hydrogen, carbon monoxide, and unreacted hydrocarbons described above can be sufficiently combusted by the CO eliminating catalyst, and this combustion heat heats up the case of the CO eliminator 13, the CO eliminating catalyst, and the fuel gas. Thereby, the warming-up of the CO eliminator 13 is accelerated. Furthermore, the fuel gas that has been quickly heated up flows downstream, and thereby the gas flow path downstream is heated up. Thus, the warm-up of the gas flow path of the internal system is also accelerated.

As a result, the quick warm-up of all of the fuel gas generating apparatus 1 becomes possible, and the quick stabilization of the composition of the fuel gas generated by the reforming reactor 10 is attained, and the fuel cell stack 21 can be quickly brought into a state in which the electric power generation is possible.

[0027]

Next, the warm-up processing sequence during the warm-up of the fuel gas generating apparatus 1 according to the present embodiment will be explained while referring to the flowchart in FIG. 2 and FIG. 3. Here, this flowchart shows the processing sequence, and does not show the flow of electrical signals.

First, when the fuel cell start-up switch is turned ON (step S101), the flow proceeds to step S102, and the three-way selector valve 34 is switched such that the fuel gas supply duct 32 and the bypass duct 38 are connected.

[0028]

Next, the flow proceeds to step S103, the warm-up of the vaporizer 22 starts, and at the same time a reforming catalyst temperature (a detected temperature) of the reformer 11 is detected. Then the flow proceeds to step S104, and it is determined whether or not the reforming catalyst temperature is lower than a threshold value T1. In the case that the determination in step S104 is positive, that is, in the case that the reforming catalyst temperature is lower than the threshold value T1, the pre-warm-up of the reforming catalyst is required, so the flow proceeds to step S105. In the case that the determination in step S104 is negative, the pre-warm-up of the reforming catalyst is not required, so the flow proceeds to step S110.

[0029]

In step S105, supply amounts of the raw liquid fuel and the air to be supplied to the start-up burner 14 are calculated. That is, based on the reforming catalyst temperature detected in step S103, the required amount for the fuel is calculated by referring to a map I shown in FIG. 4A, and the amount of the air required to combust this amount of fuel is calculated by referring to a map II shown in FIG. 4B. Finally, this air amount is corrected for the air pressure by referring to a map III shown in FIG. 4C. The reason why correcting the air amount for the air pressure is that what is actually required is not the amount of air, but the amount of oxygen.

[0030]

Next, the flow proceeds to step S106, where the fuel and the air, with amounts corresponding to the amount of fuel and the amount of air calculated in step S105 respectively, are supplied to the start-up burner 14, an ignition is carried out, and the start-up burner 14 is started. Thereby, the pre-warm-up of the reforming catalyst of the

reformer 11 is started.

[0031]

Next, the flow proceeds to step S107, the reforming catalyst temperature of the reformer 11 is detected, and in step S108 it is determined whether or not the reforming catalyst temperature is equal to or greater than a threshold value T2, which is set to a value that is higher than the threshold value T1. In the case that the determination in step S108 is negative, the pre-warm-up of the reforming catalyst is still insufficient, and thus the pre warm-up of the start-up burner 14 is continued.

[0032]

In the case that the determination in step S108 is positive, the flow proceeds to step S109, the start-up burner 14 is stopped, and the pre-warm-up is completed. The flow then proceeds to step S110, and it is determined whether or not the warm-up of the vaporizer 22 has been completed. In the case that the determination in step S110 is negative, the warm-up of the vaporizer 22 is continued.

[0033]

In the case that the determination in step S110 is positive, the flow proceeds to step S111, a reforming catalyst temperature of the reformer 11 and a CO eliminating catalyst temperature of the CO eliminator 13 are detected, then the flow proceeds to step S112, and the initial supply amounts of the raw liquid fuel and the reforming air to be supplied to the vaporizer 22 and the initial supply amount of the CO elimination air to be supplied to the CO eliminator 13 are calculated.

[0034]

In more detail, first, based on the reforming catalyst temperature detected in step S111, a required initial supply amount of the raw fuel is calculated by referring to a map IV shown in FIG. 5A. In the map IV, the solid line is used when calculating the amount of the raw fuel during the idle operation, the broken line is used when calculating the initial supply amount, and when being compared under an equal reforming catalyst temperature, the initial supply amount of the raw fuel is set to become larger than the amount supplied during an idle operation. Here, the idle operation denotes the minimum operational state for maintaining the temperature of the fuel gas generating apparatus 1.

[0035]

Next, based on the reforming catalyst temperature, a reforming air amount is calculated by referring to a map V shown in FIG. 5B. In the map V, the solid line is used when calculating the reforming air amount during the idle operation, the broken line is used when calculating the reforming air amount at the beginning of the warm-up, and when being compared under an equal reforming catalyst temperature, the supply amount of the reforming air at the beginning of the warm-up is set to become larger than the amount supplied during the idle operation.

[0036]

Next, the reforming air increase amount coefficient that depends on the reforming catalyst temperature is calculated by referring to a map VI shown in FIG. 5C, and the initial supply amount of the reforming air is calculated by multiplying the reforming air amount calculated using the map V by the increase coefficient calculated using the map VI. Then, this initial supply amount of the reforming air is corrected for the air pressure by referring to a map IX shown in FIG. 5F.

Moreover, the increase ratio of the initial supply amount of the reforming air at the beginning of the warm-up with respect to the supply amount of the reforming air during the idle operation is set to be less than five times.

In addition, the increase ratio of the initial supply amount of the reforming air at the beginning of the warm-up with respect to the supply amount of the reforming air during the idle operation is set to be greater than the increase ratio of the initial supply amount of the raw fuel at the beginning of the warm-up with respect to the supply amount of the raw fuel during the idle operation. For example, the initial supply amount of the raw fuel may be twice the supply amount of the raw fuel during the idle operation, and the initial supply amount of the reforming air may be three times the supply amount of the reforming air during the idle operation.

[0037]

Next, the amount of the CO eliminating air with respect to the initial reformed gas amount is calculated by referring to a map VII in FIG. 5D. In the map VII, the solid line is used when calculating the CO eliminating air amount during the idle operation, and the broken line is used when calculating the CO eliminating air amount at the beginning of the warm-up, and when being compared under an equal reformed gas amount, the supply amount of the CO eliminating air at the beginning of the

warm-up is set to become larger than the amount supplied during the idle operation.
[0038]

Next, the CO eliminating air increase amount coefficient that depends on the temperature of the CO eliminating catalyst detected in step S111 is calculated by referring to a map VIII shown in FIG. 5E, and the initial supply amount of CO eliminating air is calculated by multiplying the CO eliminating air amount calculated using the map VII by the increase coefficient calculated using the map VIII. Furthermore, this initial supply amount of CO eliminating air is corrected for the air pressure by referring to a map IX shown in FIG. 5F.

The reason why correcting the initial supply amounts of the reforming air and the CO eliminating air for the air pressure is that what is actually required is not the amount of air, but the amount of oxygen.
[0039]

Next, the flow proceeds to step S113, the raw fuel and the reforming air, with the initial supply amounts that have been calculated in step S112 are supplied to the vaporizer 22, and at the same time, the CO eliminating air with the initial supply amount that has been calculated in step S112 is supplied to the CO eliminator 13.

In this manner, by making the initial supply amount of the reforming air larger than the amount supplied during the idle operation, the oxygen in the reforming air supplied in excess is combusted by the reforming catalyst, and this combustion heat heats up the case of the reformer 11, the reforming catalyst, and the reformed gas. As a result, the reformer 11 can be warmed up quickly. In addition, the reformed gas heated up in this manner flows downstream, and thereby the case of the heat exchanger 12, the cooling water, and the case of the CO eliminator 13, the CO eliminating catalyst, and the gas flow paths in the system are heated up.
[0040]

In addition, by making the initial supply amount of raw fuel larger than the amount supplied during the idle operation, the amount of heat generation in the reformer 11 increases further, and thus the warm-up of the reformer 11 becomes even faster, and the warm-up of each device disposed father downstream from the reformer 11 becomes even faster. In addition, the amounts of the hydrogen, CO, and unreacted hydrocarbons that flow out from the reformer 11 can be increased.

[0041]

In addition, because the increase ratio of the initial supply amount of the reforming air at the beginning of the warm-up with respect to the supply amount of the reforming air during the idle operation is set to be greater than the increase ratio of the initial supply amount of raw fuel at the beginning of the warm-up with respect to the supply amount of raw fuel during the idle operation, the quick warm-up due to the increase in the supply amount of the raw fuel and the quick warm-up due to the increase in the supply amount of the reforming air can both be made effective.

[0042]

In addition, by making the initial supply amount of the CO eliminating air larger than the amount supplied during the idle operation, the hydrogen, carbon monoxide, and unreacted hydrocarbons flowing from the reformer 11, in addition to the oxygen in the CO eliminating air that has been supplied in excess, can be sufficiently combusted by the CO eliminating catalyst, and this combustion heat can heat up the case of the CO eliminator 13, the CO eliminating catalyst, and the cooling water for adjusting the CO eliminating catalyst temperature. As a result, the CO eliminator 13 can be quickly warmed up.

Furthermore, this combustion gas flowing downstream can heat up the gas flow path in the system. Therefore, the warm-up of the gas flow paths in the system becomes fast.

[0043]

Next, the flow proceeds from step S113 to step S114 and step S121.

When the flow proceeds to step S114, which is the processing line of the reformer 11, in step S114 a reforming catalyst temperature of the reformer 11 is detected, and then the flow proceeds to step S115, and it is determined whether or not the reforming catalyst temperature is higher than a threshold value T3. Here, the threshold value T3 is set equal to or greater than a regenerating temperature of the reforming catalyst in advance. In the case of a negative determination in step S115, that is, in the case that the reforming catalyst temperature is lower than the threshold value T3, the amounts of the raw fuel and the reforming air supplied to the vaporizer 22 are maintained at the initial supply amounts, and the operations of the vaporizer 22 and the reformer 11 continue. Here, the regeneration temperature is a temperature, at which

the deterioration of the catalyst is temporarily suppressed, or the capability of the catalyst is increased to a certain degree, and differs depending on the catalyst.

[0044]

In the case that the determination in step S115 is positive, that is, in the case that the reforming catalyst temperature is higher than the threshold value T3, the target temperature of the reforming catalyst is set to be the target temperature during the idle operation, and feedback control (hereinafter, referred to as "F/B control") of the reforming catalyst temperature starts. Moreover, the target temperature of the reforming catalyst during the idle operation is lower than the threshold value T3.

In this manner, by making the reforming catalyst temperature be equal to or greater than the regeneration temperature once, the reforming catalyst can be regenerated.

[0045]

The detailed explanation of the F/B control of the reforming catalyst temperature will be described below. The reforming air amount is calculated by referring to a map X in FIG. 6A based on the reforming catalyst temperature. In the map X, the solid line is used when calculating the reforming air amount during the F/B control of the reforming catalyst temperature, the broken line is used when calculating the reforming air amount at the beginning of the warm-up described above, and when being compared under an equal reforming catalyst temperature, the amount of the reforming air supplied during this F/B control is set to become smaller than the supply amount at the beginning of the warm-up. That is, in this F/B control, control is carried out in a direction such that the reforming air amount is decreased.

[0046]

Next, the reforming air amount calculated using the map X is corrected for the air pressure by referring to a map XI in FIG. 6B, and then based on the reforming air amount, which has been corrected for the air pressure, the raw fuel amount is calculated by referring to a map XII shown in FIG. 6C. In the map XII, the solid line is used when calculating the raw fuel amount during the F/B control of the reforming catalyst temperature, the broken line is used when calculating the raw fuel amount at the beginning of the warm-up described above, and when being compared under an equal reforming air amount, the supply amount of the raw fuel at the beginning of the

warm-up is set to become larger than the amount supplied during F/B control. That is, in this F/B control, control is carried out in a direction such that the raw fuel amount is decreased.

[0047]

In addition, the supply of the raw fuel and the reforming air to the vaporizer 22 is performed using the supply amounts calculated in this manner. Thereby, the reforming catalyst temperature converges to the above described target temperature during the idle operation by gradually decreasing, and as a result, the deterioration of the reforming catalyst due to needless exposures to high temperatures can be prevented.

[0048]

Next, the flow proceeds to step S117, and a temperature of the case of the reformer 11, a reforming catalyst temperature, a reformed gas temperature, and a reformed gas flow volume are detected. Then, the flow proceeds to step S118, and based on each of the detected values that have been detected in step S117, it is determined whether or not the warm-up of the reformer 11 has been completed. That is, it is determined whether or not each of the temperature of the case of the reformer 11, the reforming catalyst temperature, the reformed gas temperature, and the reformed gas flow volume detected in step S117 falls within a setting range during the idle operation (hereafter, referred to as the "idle setting ranges"), which has been set in advance for each of the detected items. If every one of these detected values falls within the respective idle setting ranges, it is determined that the warm-up of the reformer 11 has been completed, and if even one among the detected values falls outside of the set range, it is determined that the warm-up is not yet completed. In this manner, the completion of the warm-up of the reformer is determined based on a plurality of detected values, and thus the determination of the completion of the warm-up can be carried out accurately.

[0049]

In the case that the determination in step S118 is negative, the flow returns to step S116, and the F/B control of the reforming catalyst temperature is continued. In the case that the determination in step S118 is positive, the flow proceeds to step S119, and the vaporizer 22 and the reformer 11 are operated under the idle operation conditions. Then the flow proceeds to step S120, and it is determined whether or not

the warm-up of the CO eliminator 13 has been completed. In the case that the determination in step S120 is negative, the flow returns to step S119, and the operations of the vaporizer 22 and the reformer 11 are continued under the idle operation conditions.

[0050]

On the other hand, when the flow proceeds from step S113 to step S121, which is the processing line of the CO eliminator 13, a CO eliminating catalyst temperature of the CO eliminator 13 is detected in step S121. Then, the flow proceeds to step S122, and it is determined whether or not the CO eliminating catalyst temperature is larger than a threshold value T4. Here, preferably the threshold value T4 is set in advance to be equal to or greater than the regeneration temperature of the CO eliminating catalyst. In the case that the determination in step S122 is negative, that is, in the case that the CO eliminating catalyst temperature is lower than the threshold value T4, the amount of the CO eliminating air supplied to the CO eliminator 13 is maintained at the initial supply amount and the operation of the CO eliminator 13 is continued.

In this manner, by once making the CO eliminating catalyst temperature increase to become equal to or greater than the regeneration temperature, the CO eliminating catalyst can be regenerated, and the operating life of the catalyst is extended.

[0051]

On the other hand, in the case that the determination in step S122 is positive, that is, in the case that the CO eliminating catalyst temperature is greater than the threshold value T4, the target temperature of the CO eliminating catalyst is set to the target temperature during the idle operation, and the F/B control of the CO elimination catalyst temperature is started. Here, the target temperature of the CO eliminating catalyst during the idle operation is lower than the threshold value T4.

[0052]

The F/B control of the CO eliminating catalyst temperature will now be explained in detail. First, the CO eliminating air amount is calculated by referring to a map XIII shown in FIG. 7A, based on the reformed gas amount. Here, the map XIII is practically identical to the map VII in FIG. 5D. In the map XIII, the solid line is used when calculating the CO eliminating air amount during the F/B control of the CO

eliminating catalyst temperature, while the broken line is used when calculating the CO eliminating air amount at the beginning of the warm-up described above, and when being compared under an equal reforming air amount, the amount of the CO eliminating air supplied during this F/B control is set to become smaller than the amount supplied at the beginning of the warm-up. That is, in this F/B control, the control is carried out in a direction such that the CO eliminating air amount is decreased.

[0053]

Next, the CO eliminating air increase amount coefficient is calculated by referring to a map XIV shown in FIG. 7B based on the CO eliminating catalyst temperature, and the CO eliminating air amount is calculated by multiplying the CO eliminating air amount calculated using the map XIII by the increase amount coefficient calculated using the map XIV. Then, this CO eliminating air amount is corrected for the air pressure by referring to a map XV shown in FIG. 7C.

Then, the supply of the CO eliminating air to the CO eliminator 13 is performed using the supply amount calculated in this manner. Thereby, the CO eliminating catalyst temperature converges to the target temperature during the idle operation by gradually falling, and as a result, the deterioration of the CO eliminating catalyst due to needless exposures to high temperatures can be prevented. In addition, at the same time the CO eliminating air amount supplied to the CO eliminator 13 is being decreased.

[0054]

Next, the flow proceeds to step S124, and a case temperature of the CO eliminator 13, a CO eliminating catalyst temperature, a temperature of the fuel gas that flows out from the CO eliminator 13, a fuel gas flow volume, and a case temperature of the three-way selector valve 34 are detected. Then the flow proceeds to step S125, and based on each of the detected values detected in step S124, it is determined whether or not the warm-up of the CO eliminator 13 has been completed. That is, it is determined whether or not each of the case temperature of the CO eliminator 13, the CO eliminating catalyst temperature, the fuel gas temperature, the fuel gas flow volume, and the case temperature of the three-way selector valve 34 falls within a setting range during the idle operation, which is set in advance for each of the detected items (hereafter, referred to as the “idle setting ranges”). If every one of these detected

values falls within the respective idle setting ranges, it is determined that the warm-up of the CO eliminator 13 has been completed, while if any one of the detected values falls outside of the setting range, it is determined that the warm-up has not been completed. In this manner, the completion of the warm-up of the CO eliminator 13 is determined based on a plurality of detected values, and thus the warm-up completion determination can be carried out accurately.

[0055]

In the case that the determination in step S125 is negative, the flow returns to step S123, and the F/B control of the CO eliminating catalyst temperature is continued. When the determination in step S 25 is positive, the flow proceeds to step S126, and the CO eliminator 13 is operated under the idle operation conditions. Then the flow proceeds to step S127, and it is determined whether or not the warm-up of the reformer 11 has been completed. In the case that the determination in step S127 is negative, the flow returns to step S126, and the CO eliminator 13 continues to operate under the idle operation conditions.

[0056]

Then, in the case that warm-up operations of both the reformer 11 and the CO eliminator 13 have completed, the flow proceeds to step S128 from step S120 and step S127, a CO concentration value and a THC concentration value in the fuel gas flowing out from the CO eliminator 13 are detected, and based on these detected values, it is determined whether or not the fuel gas composition has stabilized. In other words, in the case that one of the CO concentration value and the THC concentration value in the fuel gas is greater than the corresponding one of the maximum values set in advance, it is determined that the fuel gas composition has not stabilized, and in the case that each one of them is equal to or lower than the respective maximum values described above, it is determined that the fuel gas composition has stabilized.

Here, it is also possible to determine that the gas composition has stabilized by waiting a predetermined period of time using a timer or the like from a time when it is determined that the warm-up operations of both the reformer 11 and the CO eliminator 13 have been completed. By doing in this way, the system structure can be simplified and costs can be reduced.

[0057]

In the case that the determination in step S129 is negative, the flow returns to step S128, and the previous operating state continues, while in the case that the determination in step S129 is positive, the flow proceeds to step S130, the three-way selector valve 33 is connected to the fuel gas supply duct 33, the fuel gas flows into the fuel cell stack 21, and the electric power generation is enabled.

[0058]

FIG. 8 is a drawing that compares, for the cases of the present invention and the conventional technology, the changes in the reforming air supply amount and the fuel vapor supply amount with the passage of time from a time when the fuel cell start-up switch is turned ON. Conventionally, immediately after the warm-up of the vaporizer has been completed, the reforming air amount and the fuel vapor amount for the idle operation after completion of the warm-up are supplied. However, according to the present invention, immediately after completion of the warm-up of the vaporizer, excess amounts of the fuel vapor and the reforming air compared to the conventional amounts are supplied, then the excess amounts are gradually decreased accompanying the progress of the warm-up of the reformer 11, and finally converge to the supply amounts for the idle operation after the completion of the warm-up.

[0059]

FIG. 9 is a drawing comparing, for the cases of the present invention and the conventional technology, the changes in the amount of generated heat in the reformer reactor 10 with the passage of time from a time when the fuel cell start-up switch is turned ON. Conventionally, the amount of generated heat in the reforming reactor is constant from the completion of the warm-up of the vaporizer to the completion of the warm-up of the entire fuel gas generating apparatus. However, according to the present invention, the amount of heat generated in the reforming reactor 10 immediately after completion of the warm-up of the vaporizer is significantly larger than the conventional amount, is gradually decreased accompanying the progress of the warm-up of the reforming reactor 10, and then finally converges to the amount of generated heat for the idle operation after the completion of the warm-up.

[0060]

FIG. 10 is a drawing comparing, for the cases of the present invention and the conventional technology, the changes in the CO eliminating air supply amount, and an

equivalence air for combusting the unreacted HC as well as the CO, with the passage of time from a time when the fuel cell start-up switch is turned ON. Conventionally, immediately after the completion of the warm-up of the vaporizer, the CO eliminating air amount for the idle operation after completion of the warm-up is supplied.

However, according to the present invention, immediately after completion of the warm-up of the vaporizer, an excess amount of the CO eliminating air when compared to the conventional technology is supplied, and this amount is gradually decreased accompanying the progress of the warm-up of the CO eliminator 13, and finally converges to the supply amount for the idle operation after completion of the warm-up. The same tendency exists for the equivalence air for combusting the unreacted HC and CO.

[0061]

FIG. 11A is a drawing comparing, in the cases of the present invention and the conventional technology, the changes in the reforming catalyst temperature, with the passage of time from a time when the fuel cell start-up switch is turned ON. FIG. 11B is a drawing comparing, in the cases of the present invention and the conventional technology, the changes in the CO eliminating catalyst temperature, with the passage of time from a time when the fuel cell start-up switch is turned ON. FIG. 11C is a drawing comparing, in the cases of the present invention and the conventional technology, the changes in the wall surface temperature of the three-way selector valve 34, with the passage of time from a time when the fuel cell start-up switch is turned ON. FIG. 11D is a drawing comparing, in the cases of the present invention and the conventional technology, the changes in the CO concentration value and the THC concentration value in the fuel gas, with the passage of time from a time when the fuel cell start-up switch is turned ON.

It is clear from FIG. 11A through FIG. 11D that the warm-up of the reformer 11, the warm-up of the CO eliminator 13, the warm-up of the gas flow path in the system, and the stabilization of the fuel gas composition occur faster than the conventional technology.

[0062]

Moreover, in the fuel gas generating apparatus 1 of the present embodiment, when the air amount is calculated, a correction for the air pressure is carried out.

Accordingly, the warm-up can be carried out quickly, even if the start-up is performed in any place from at a low altitude to a high altitude.

[0063]

In this manner, in this fuel gas generating apparatus 1, the warm up of all of the reformer 11, the CO eliminator 13, and the system gas flow path is carried out more quickly than the conventional technology, and in addition, the fuel gas composition is stabilized more quickly than the conventional technology. Therefore, it is possible to shorten the period of time required from the start of the operation of the fuel cell stack 21 to a time when the electric power generation is enabled.

[0064]

Moreover, in the embodiment described above, the reduction control of the CO eliminating air amount was carried out using the F/B control, but the present invention is not limited to this type of control method. For example, control can be carried out such that the CO eliminating air amount is reduced at a constant slope over a predetermined time interval. In this case, when the CO eliminating air reaches the supply amount during the idle operation, the reduction control is stopped. By doing in this way, the control can be simplified, and at the same time, because the reduction control can be stopped at the most important CO eliminating air amount for eliminating CO, more accurate control becomes possible.

[0065]

In the embodiment described above, even though the idle operation is defined as the minimum operational state for maintaining the temperature of the fuel gas generating apparatus, the idle operation can also be defined as the minimum operational state for operating the fuel cell, the minimum operational state for maintaining the temperature of the reformer, or the minimum operational state for maintaining the temperature of the CO eliminator.

[0066]

[Effects of the Invention]

As explained above, according to claim 1 of the present invention, during warm-up, oxygen in the air that is supplied in excess to the reformer is combusted by a catalyst inside the reformer, the reformer and the reformed gas are heated up, and thus the quick warm-up of the reformer becomes possible. Furthermore, the CO eliminator

and the gas flow path in the system are heated up by the heated reformed gas flowing downstream, and thus the quick warm-up of the CO eliminator as well as the gas flow path in the system becomes possible. As a result, superior effects are obtained such that the fuel gas composition can be quickly stabilized, and that it is possible to quickly generate the electric power using the fuel cell.

[0067]

According to claim 2 of the present invention, during warm-up, the amount of generated heat in the reformer is increased further, and thus the warm-up of the reformer is quickened, and at the same time the amounts of the hydrogen, the CO, and the unreacted hydrocarbons flowing out from the reformer during the warm-up are increased. As a result, superior effects are obtained such that the amount of generated heat in the CO eliminator is also increased, and that the warm-up of the CO eliminator is also quickened.

[0068]

According to claim 3 of the present invention, the amount of oxygen that is combusted by the catalyst in the reformer can be secured, and as a result both the quick warm-up due to the increased supply amount of the raw liquid fuel and the quick warm-up due to the increased supply amount of the reforming air become effective.

According to claim 4 of the present invention, the overheating of the catalyst in the reformer can be prevented, and thus the deterioration of the catalyst due to overheating can be prevented.

[0069]

According to claim 5 of the present invention, the warm-up state of the reformer can be gradually stabilized, and thus the reformer can be reliably guided to the completion of the warm-up.

According to claim 6 of the present invention, when the reformer has been warmed up to a predetermined state, the supply amount of the reforming air, to which an increase correction has been performed, can be controlled so as to be reduced, and as a result the overheating of the catalyst in the reformer can be reliably prevented.

[0070]

According to claim 7 of the present invention, during the warm-up, the hydrogen, the carbon monoxide, and the unreacted hydrocarbons flowing out from the

reformer can be sufficiently combusted by the catalyst in the CO eliminator, along with the oxygen in the CO eliminating air that is supplied in excess, and due to this combustion heat, the CO eliminator can be heated up. Furthermore, the gas flow path in the system can be heated up due to this combustion gas flowing downstream. Accordingly, the quick warm-up of the CO eliminator and the gas flow path in the system becomes possible. As a result, superior effects are obtained such that the fuel gas composition can be quickly stabilized and that the quick electric power generation by the fuel cell becomes possible.

[0071]

According to claim 8 of the present invention, the fuel gas that has been controlled to have a predetermined gas composition and a predetermined gas temperature can be supplied to the fuel cell, and thus the electric power generating state of the fuel cell can be stabilized.

[Brief Description of the Drawings]

[Figure 1]

FIG. 1 is a drawing showing a general configuration of a fuel gas generating apparatus for a fuel cell according to an embodiment of the present invention.

[Figure 2]

FIG. 2 is a flowchart (one of two) of the warm-up processing for the fuel gas generating apparatus described above.

[Figure 3]

FIG. 3 is a flowchart (two of two) of the warm-up processing for the fuel gas generating apparatus described above.

[Figure 4]

FIGs. 4A to 4C are maps for calculating an amount of fuel and an amount of air supplied to the start-up burner in the fuel gas generating apparatus described above.

[Figure 5]

FIGs. 5A to 5F are maps for calculating the initial supply amounts of raw fuel, reforming air, and CO eliminating air in the fuel gas generating apparatus described

above.

[Figure 6]

FIGs. 6A to 6C are maps for calculating the supply amounts of a raw fuel and reforming air when carrying out F/B control of the reforming catalyst temperature in the fuel gas generating apparatus described above.

[Figure 7]

FIGs. 7A to 7C are maps for calculating the supply amount of CO eliminating air when carrying out the F/B control of the CO eliminating catalyst temperature in the fuel gas generating apparatus described above.

[Figure 8]

FIG. 8 is a drawing showing the changes in the amount of supplied reforming air and the amount of supplied fuel vapor, with the passage of time from the beginning of the operation.

[Figure 9]

FIG. 9 is a drawing showing the changes in the amount of heat generated in the reforming reactor, with the passage of time from the beginning of the operation.

[Figure 10]

FIG. 10 is a drawing showing the changes in the amount of supplied CO eliminating air, with the passage of time from the beginning of the operation.

[Figure 11]

FIGs. 11A to 11D are drawings showing the changes in the reforming catalyst temperature, the CO eliminating catalyst temperature, the wall surface temperature, and the fuel gas composition, with the passage of time from the beginning of the operation.

[Brief Description of the Reference Symbols]

1 : FUEL GAS GENERATING APPARATUS FOR A FUEL CELL

11 : REFORMER (AUTO THERMAL REFORMER)

13 : CO ELIMINATOR

21 : FUEL CELL STACK (FUEL CELL)

22 : VAPORIZER

S112 : REFORMING AIR AMOUNT CONTROL MEANS, FUEL AMOUNT

CONTROL MEANS, CO ELIMINATING AIR AMOUNT CONTROL MEANS

FIG. 1

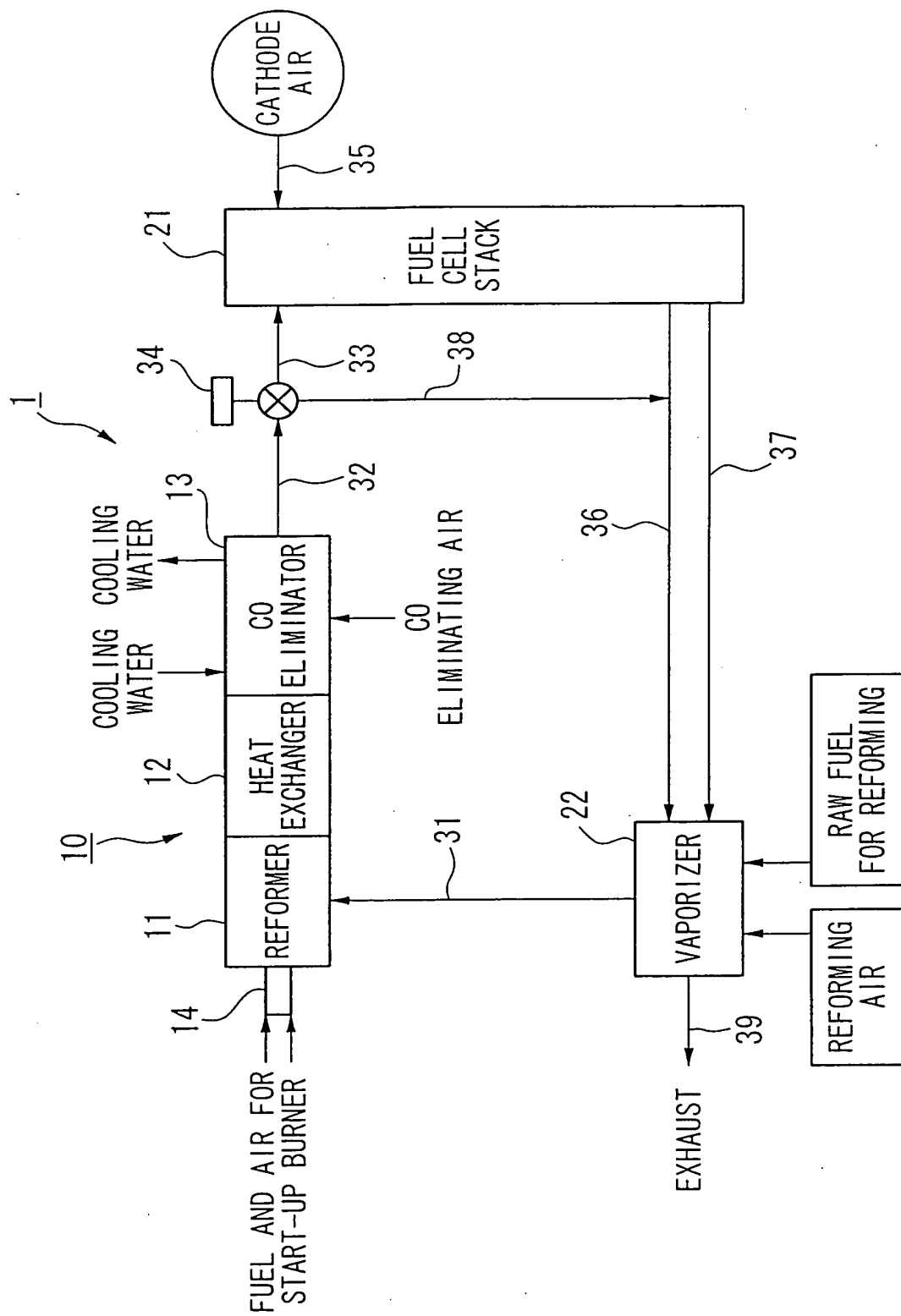


FIG. 2

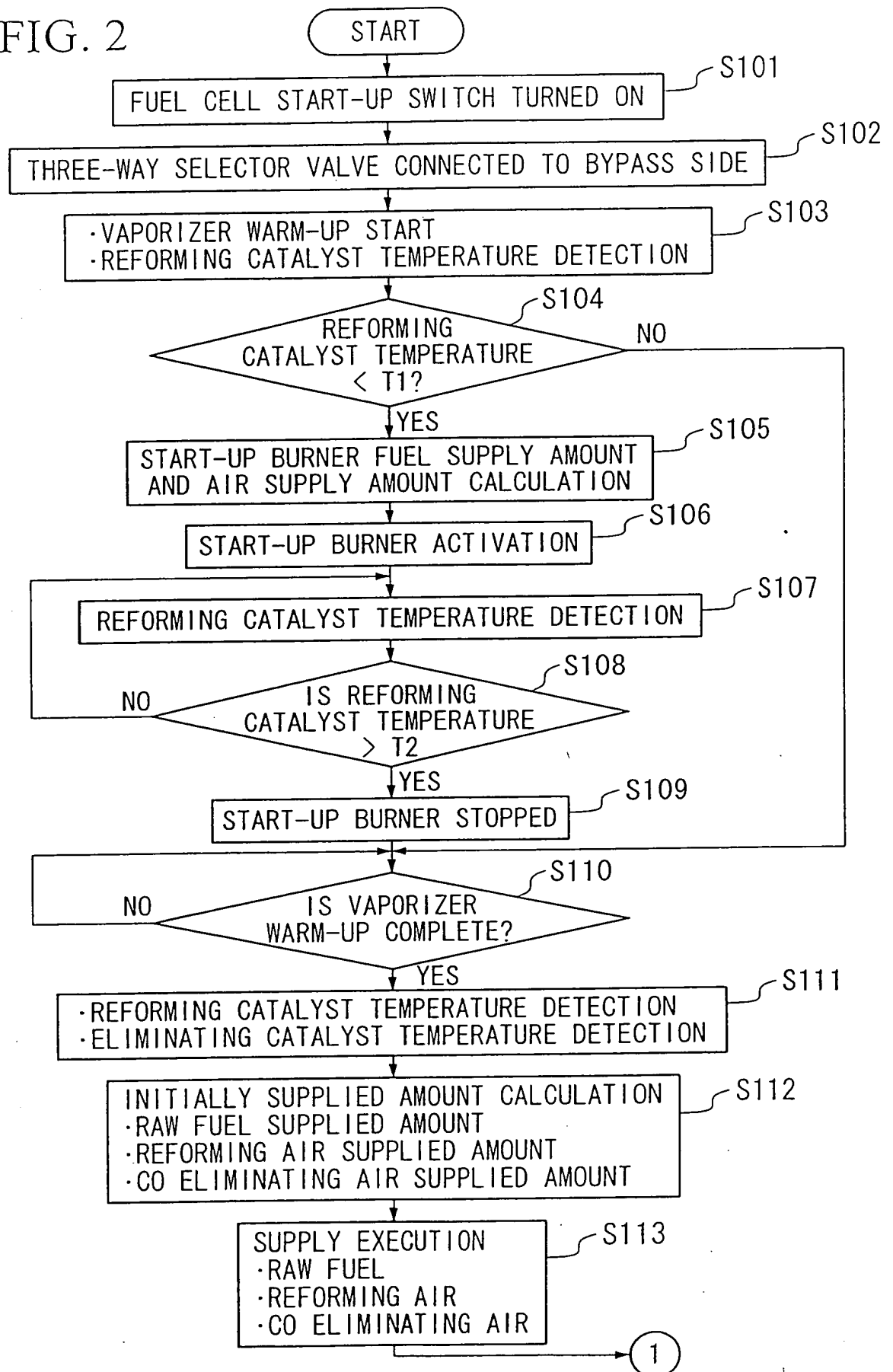


FIG. 3

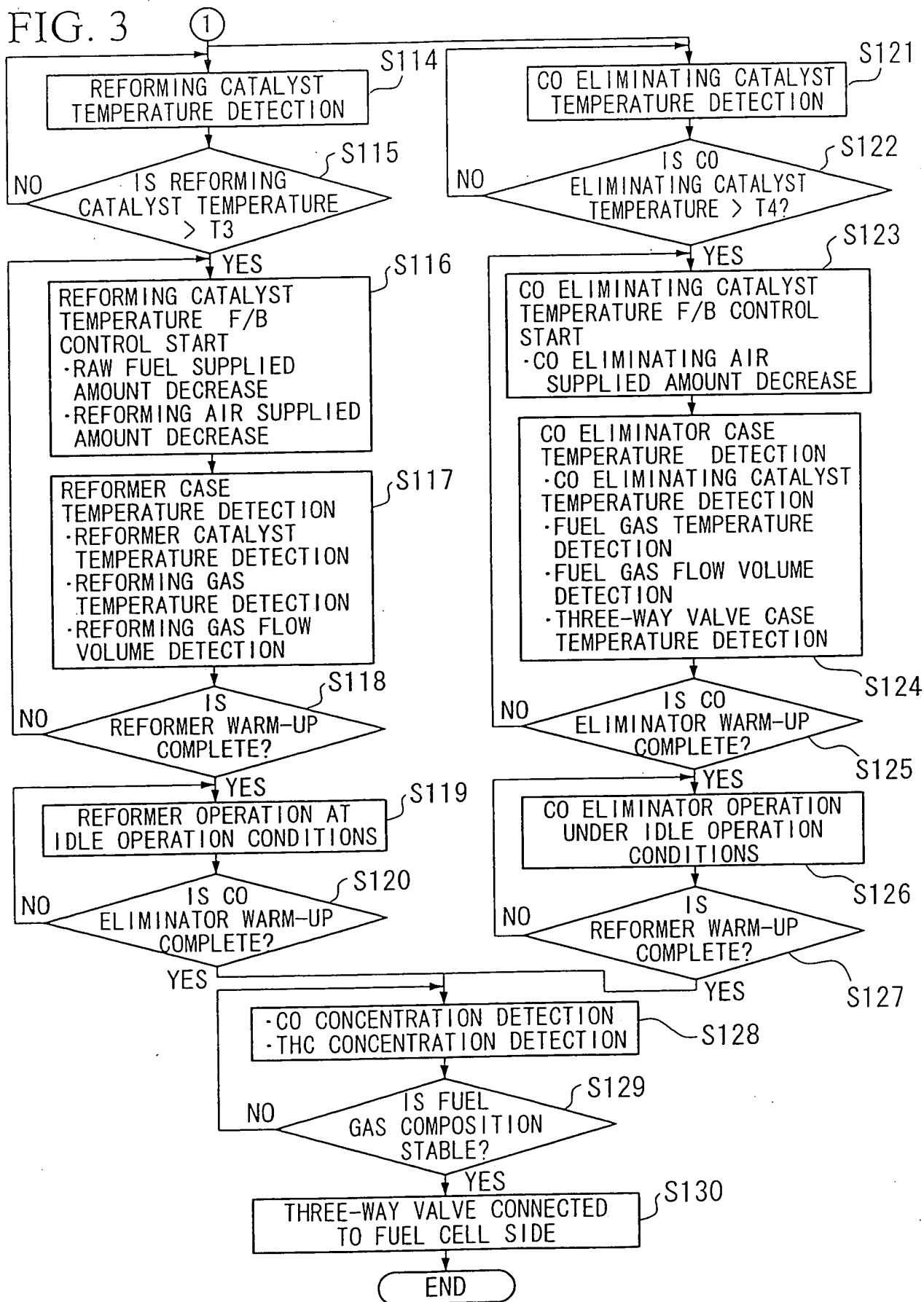


FIG. 4A

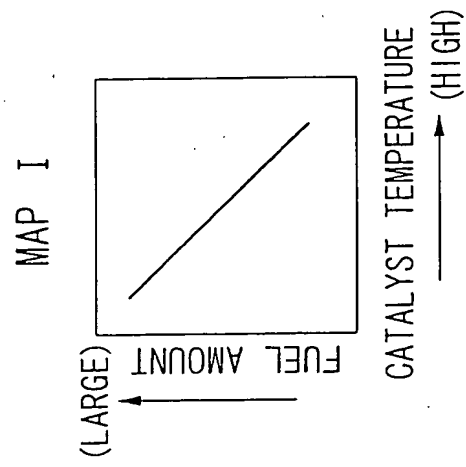


FIG. 4B

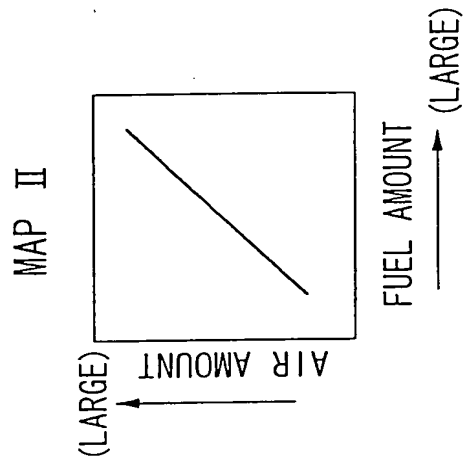


FIG. 4C

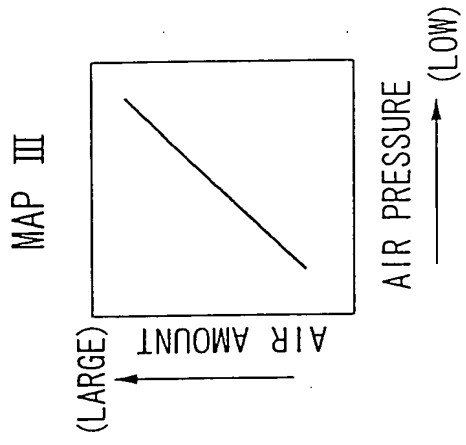


FIG. 5A

MAP IV

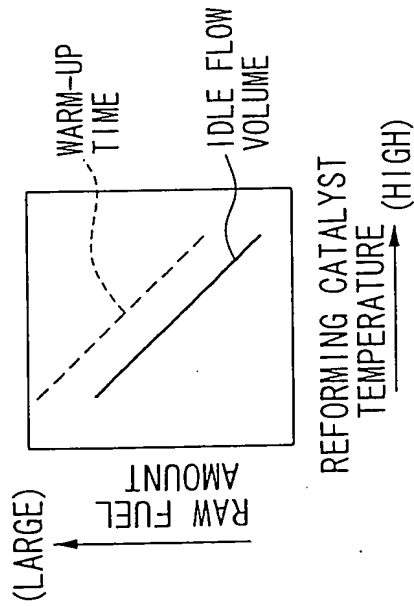


FIG. 5B

MAP V

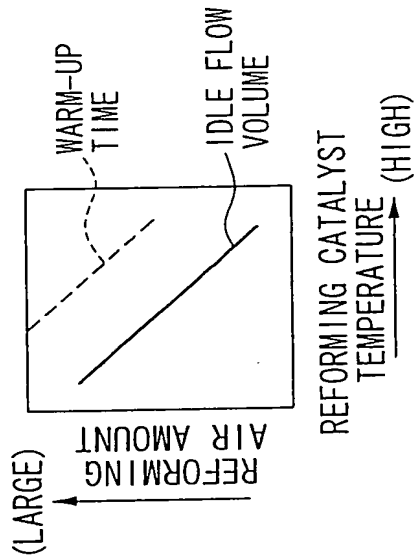


FIG. 5C

MAP VI

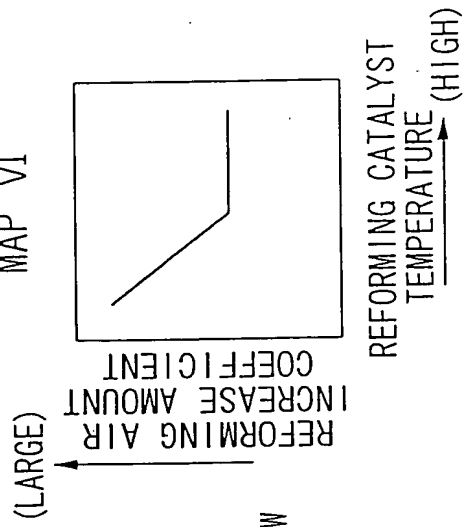


FIG. 5D

MAP VII

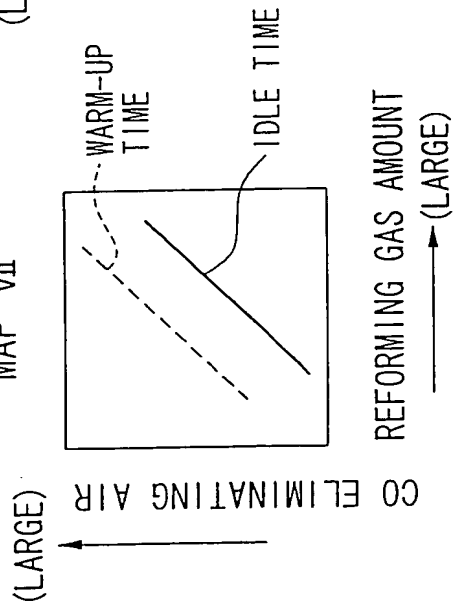


FIG. 5E

MAP VIII

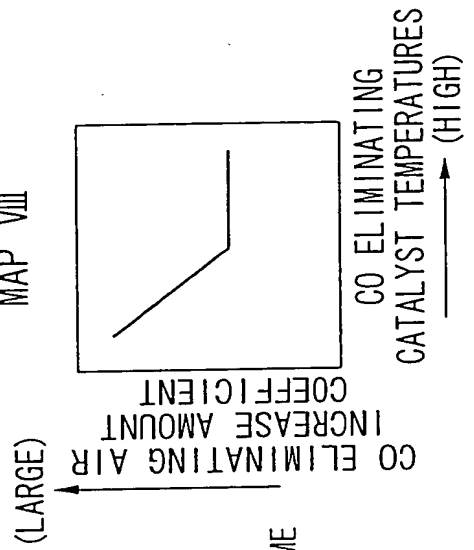


FIG. 5F

MAP IX

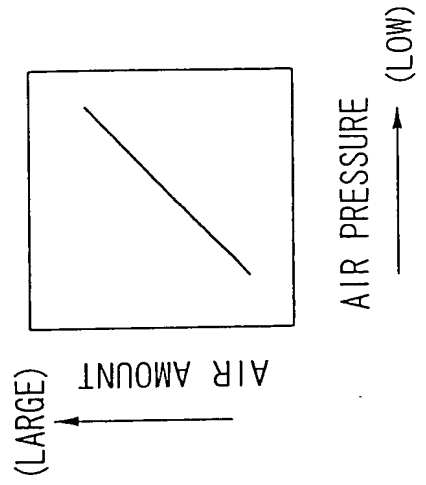


FIG. 6A

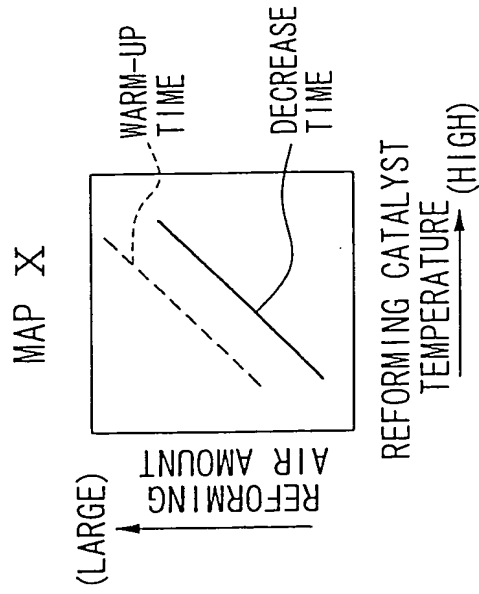


FIG. 6B

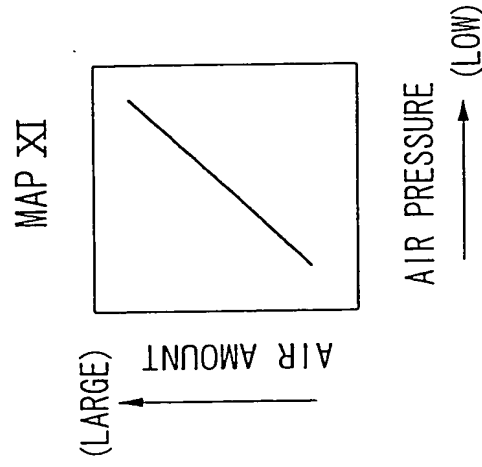


FIG. 6C

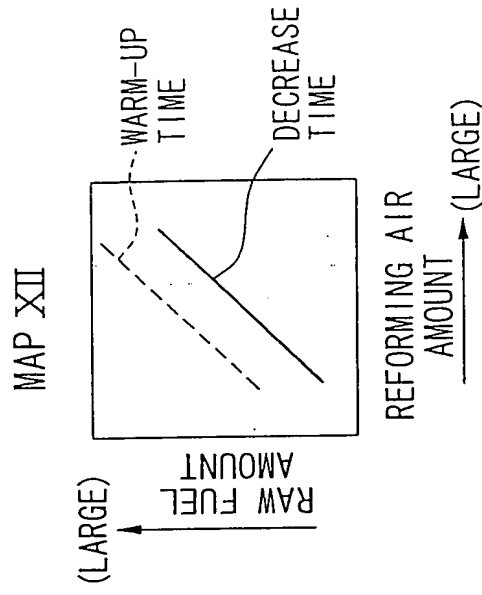


FIG. 7A

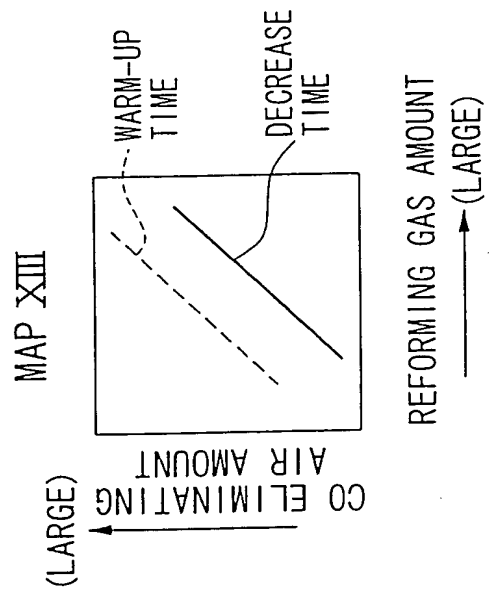


FIG. 7B

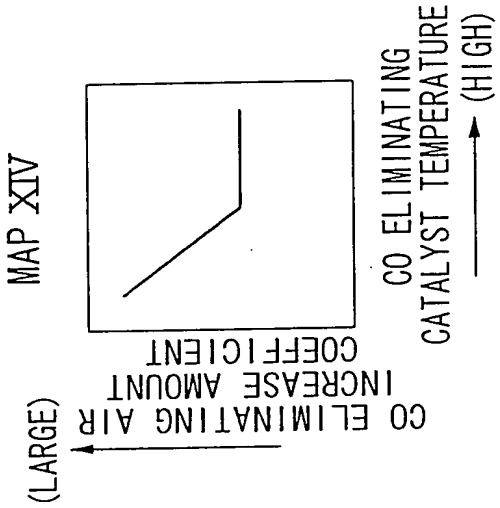


FIG. 7C

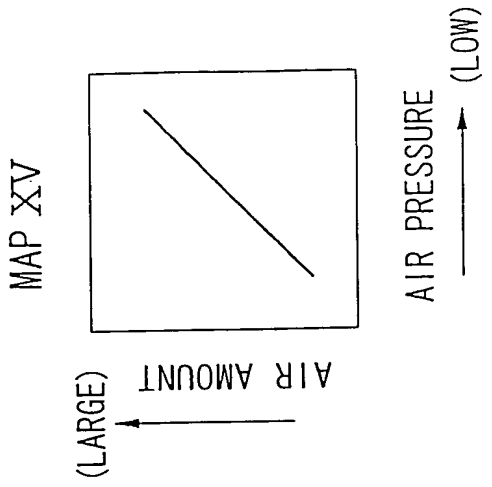


FIG. 8

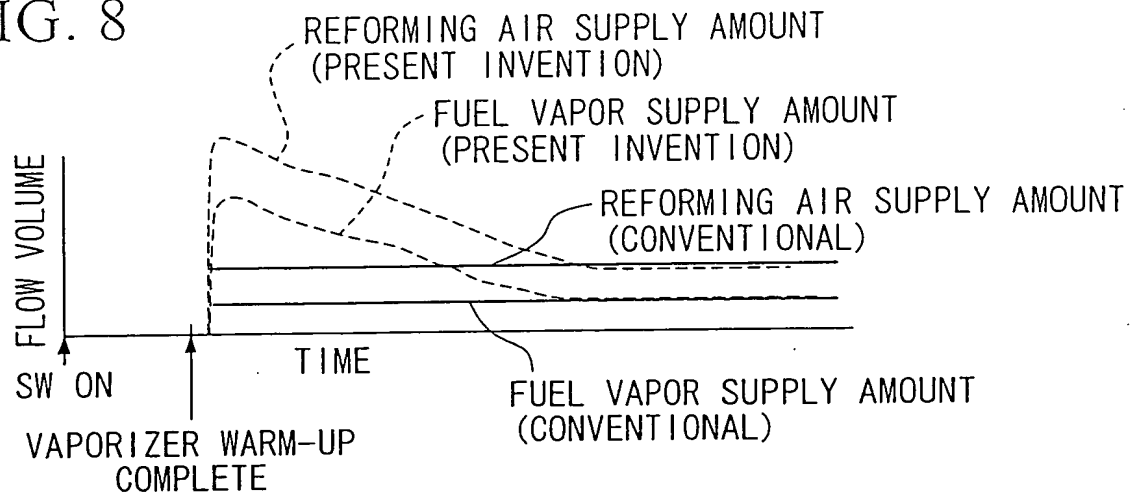


FIG. 9

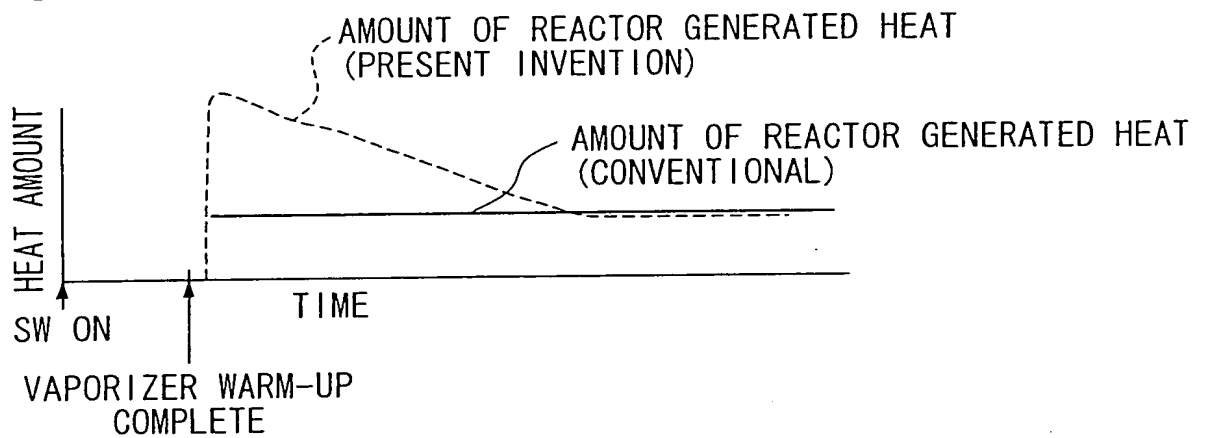


FIG. 10

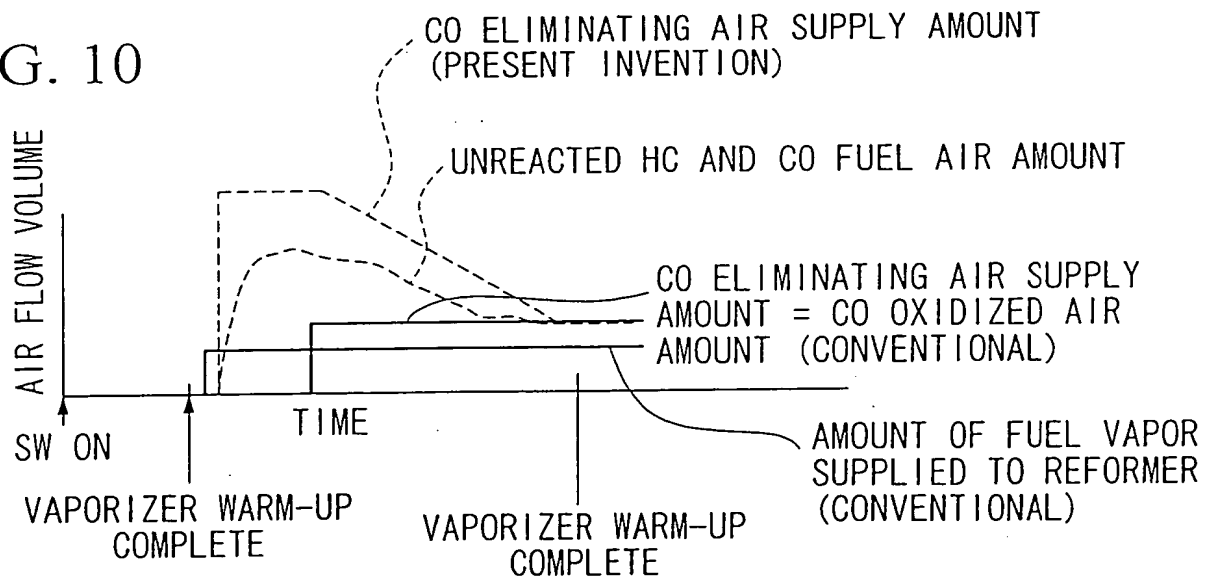


FIG. 11A

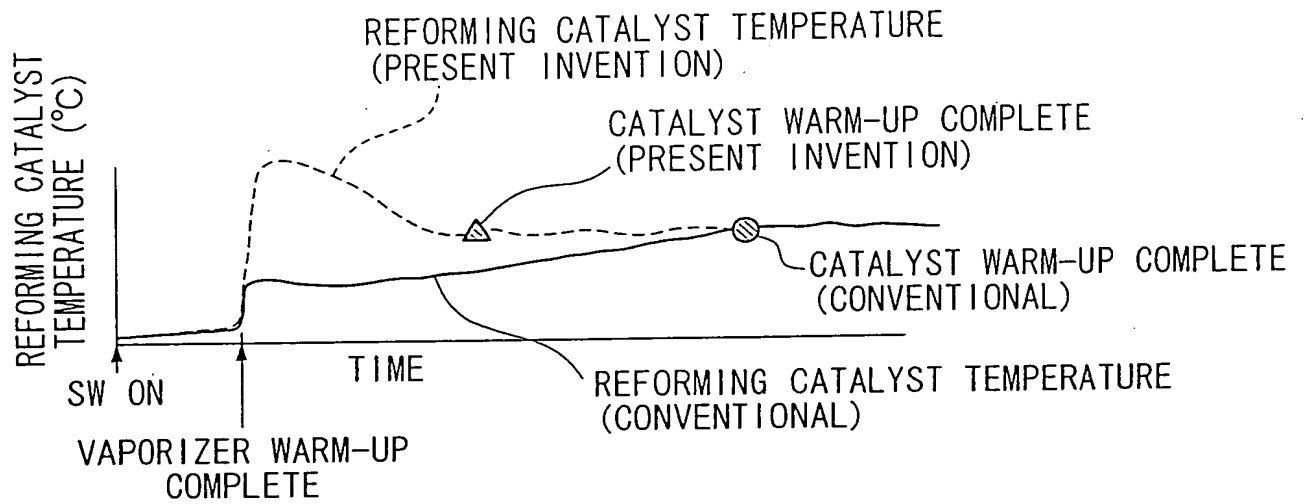


FIG. 11B

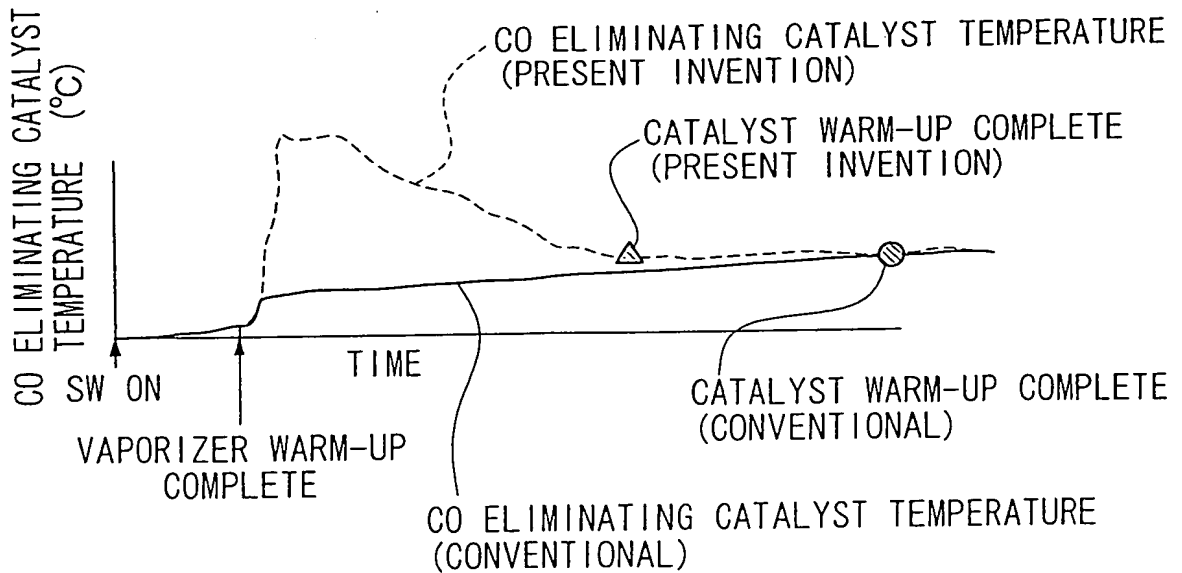


FIG. 11C

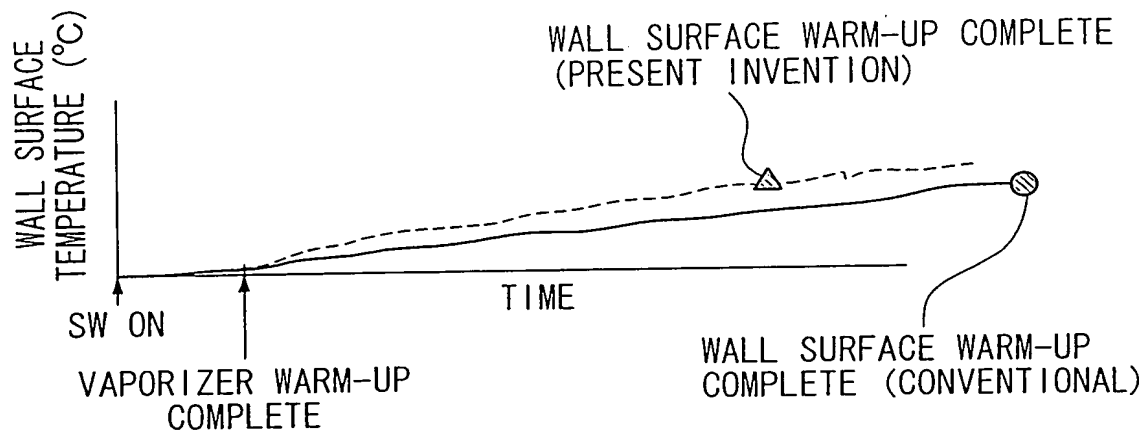
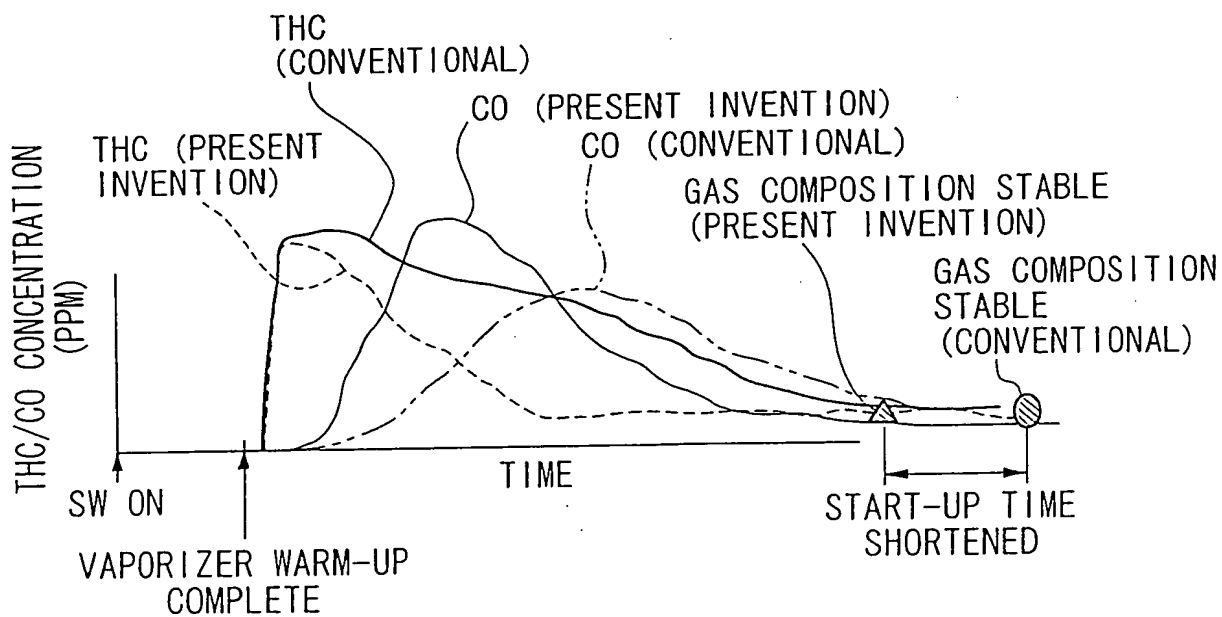


FIG. 11D



[Document Type] Abstract

[Abstract]

[Problem to be Solved by the Invention]

To improve a start-up operation of a fuel gas generating apparatus for a fuel cell, having an auto thermal reformer.

[Means for Solving the Problem]

In a fuel gas generating apparatus 1 for a fuel cell comprising: a vaporizer 22 for generating a fuel vapor by vaporizing a raw liquid fuel; an auto thermal reformer 11 for generating a reformed gas containing hydrogen from a partially oxidized raw fuel gas obtained by adding reforming air to the fuel vapor generated by the vaporizer; and a CO eliminator 13 for generating a fuel gas by eliminating carbon monoxide from the reformed gas generated by the auto thermal reformer, by adding CO eliminating air; it is controlled such that the supply amount of the reforming air during a warm-up operation of the reformer becomes larger than the supply amount of the reforming air during an idle operation after completion of the warm-up operation.

[Elected Drawing] FIG. 1

Patent Application No. 2000-391703

Information on Applicant

Identification Number	(000005326)
1. Renewal Date	September 6, 1990
(Reason)	New Registration
Address	1-1, Minamiaoyama 2-chome, Minato-ku, Tokyo
Name	Honda Giken Kogyo Kabushiki Kaisha

No. 2001-3102172